11/11/2012 30/2013 P- 16

January 4, 1995

H-785750

Mr. Woolsey Finnell NASA Marshall Space Flight Center, AL 35812

This Final Report summarizes the activities performed by Science Applications International Corporation (SAIC) under Purchase Order H-78575B "AR&C Ground Project Planning Technical Schedules Analysis". This Purchase Order provided technical services to the Marshall Space Flight Center's AR&C Business Management Office for the period April 22, 1994 through December 31, 1994.

The major thrust of the services provided to the AR&C Business Management Office consisted of two major tasks. One involved the orientation and training of Ms. Carolyn Clifford, the new AR&C Program Analyst. Ms. Clifford was familiarized with the current AR&C programmatic and technical activities, the layout and logic of the AR&C schedules, and trained in the usage of FastTrack Schedule. The second was the development and baselining of schedules for the ground program.

In addition, SAIC participated in a May 1994 Quarterly Review, an August 1994 Status Review, a November 1994 Quarterly Review, monthly schedule inputs to the Lenoir Report, and weekly Systems Engineering & Integration meetings. Specifically, this participation involved interfacing with engineering personnel to obtain data for the development of detailed technical schedules and providing in-depth analysis of product need dates and the inter-relationships of technical tasks and schedules. For the Quarterly Reviews, each schedule was developed with the collaboration of the responsible design engineers and then presented by that engineer at the review.

During this period of performance, due primarily to budget uncertainties, the AR&C project has continued to re-plan for a ground program. The program currently utilizes six top level and detailed schedules to capture product need dates and the inter-relationships of technical tasks. These schedules include the Top Level, Systems Engineering, Hardware Development, Software Development, System Verification, and the Near Term Milestones. The Top Level schedule is used most often to depict the status of the program, while the other schedules are used to track the lower, more detailed levels of work being performed by AR&C personnel and to feed the Top Level schedule.

The re-planning for a ground program required frequent, major changes to the program schedules. Due to this frequency of changes, the program office decided to allow unlimited modification to the Top Level schedule until the May 1994 Quarterly Review at which time this schedule was baselined at Mr. Gene Beam's request. Due to the fact that the detailed schedules capture data at such a low level we did not present these

N95-70662

Unclas

0039808

PROJECT PLANNING TECHNICAL SCHEDULES ANALYSIS Final Report, Apr. - 31 Dec. 1994 (Science Applications International Corp.) schedules at the May Quarterly and allowed unchallenged changes to be made until September 1994 at which time they were baselined. This additional time was necessary due to the changeable nature of the program and to aid the responsible design engineers in planning low level programmatic and technical activities on a time scale that they felt confident they could meet.

Since the schedules have been baselined, changes that impact the delivery of an item, the start date of another activity, or the date of the final system test require a "AR&C Schedule Change Request Form" to be filed with the AR&C Business Management Office. That change must be justified by the responsible design engineer and approval must be gained from Mr. Dallais Pearson, the AR&C Chief Engineer, and Mr. Gene Beam, the AR&C Project Manager. The baselining of the schedules has provided a discipline in the system and has dramatically decreased the number of schedule changes. This has forced the engineers involved to be more aware of the schedule impacts and the inter-relationships of the total program.

A need continues to exist in the AR&C Business Management Office for technical schedule analyses. However, the analyses need to be expanded to involve the use of schedules as a tool for problem tracking, program control, and budget analysis. This broadened activity would be extremely useful to the AR&C program in determining budget impacts based on schedule changes and would prove invaluable for the continued development and implementation of the AR&C ground program. In addition, the program could use a management information system that integrates the costs and schedules and provides tracking of the procurement and financial data. SAIC has extensive experience with scheduling and networking for the AR&C program and has a full understanding of the current state of the program. SAIC is fully capable of delivering this expanded level of management and technical analyses in a timely manner.

Attached are the latest baselined AR&C program schedules. These schedules have been significantly improved in continuity and logic when compared to those schedules that existed in April 1994. While the transition from a flight program to a ground program has been difficult and has required constant revision of the schedules, the attached schedules accurately and thoroughly depict the current AR&C ground program.

NEAR-TERM SCHEDULE

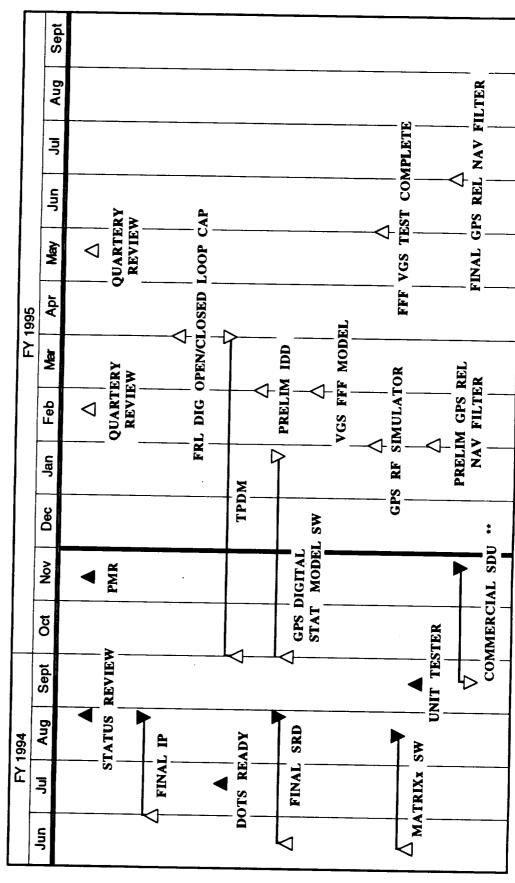
PROGRAM/CENTER:

AR&C/MSFC (GROUND PROGRAM)

(GROUNI

AR&C - N/A

PROJECT/CONTRACT:



* GSE GPS Processor deleted
** Commercial FEU changed to Commercial SDU

A/O: 11/30/94

								,													
Activity Name	<u>ک</u> ا	-	ပ	CY 92		ŀ	CY 93	<u>س</u>		CY 94	な	-	ပ	CY 95	-	ن	CY 96			CY 97	
	3 4	_	7	m	4		2	3 4	-	2	3	4	7	3	4	1	~	4	7	7	
PROGRAM MILESTONES						†	Project Plan	ج ا			1		 		-	-	,	1		-	1
							๕≈	Program Review		- & & -	Program Review			Program Review	♦		 Program Review	\$	Final Report	<u></u>	
							<u>~</u>	Preliminary SRD <	ماج	+ \	Final SRD	<u>_</u> a			HDW CH		— ₹		·— <u>}</u>	—— i	
SYSTEMS ENGINEERING System Requirements								H			++		$\downarrow \downarrow$				\rightarrow	oystelli	2	mbiene	
		-				Initia Red	Initial Operations Requirements						Peratio	Operations Concept Document	ot Docur	- peut					
System Integration		_					+		Zig	Nite Hawks Installed	nstalled	L			-				-	1	
						ნ	Closed/Open Loop Sensor Tests	Sensor Tests		& Operating	ting		>	FRL Rdy for Final GN&C & OBC	for Final t OBC		———> ———>		RC Syste ability	— g –	
							-			DOTS Ready	(cady	Dig Open/Closed Loop Capability	en/Clos	3 8							
Documentation		ļ_	\perp		-	+		+	-		-	1	+	1		\downarrow		-	\dashv		
								Prelim SRD Prelim IP	Final SRD	-9 -	F F	First	veri	Verification Plan					> కి	Verif Rqmis Compliance Doc	
ARDWARE DEVELOPMENT		_	\perp		-	+	+		-				\downarrow		+	-		1			
Video Guidance Sensor (VGS)						 	Breadboard Model VGS	Wo Mo	- AGS		E <	Available	→ '-	FFF Test Complete	Figr VGS Complete	1 1	Figt VGS Test Complete	¥ .			
Three Point Docking Mechanism							-						JL		1						
Electronics					- ×	Single C	Controller	b		Three Latch	atch Con	Controller	 		Test complete	mplete					
Mechanism										Latch	Latches 2-4 Assembled				+	-		-			
				· n		First L	First Latch Assembly	sembly		4	1		- ₩ >-	Mechanism Available	D.M.) Availabl -	<u>.</u> –					
Cables					-			-							_						
On Board Computer					-		 					<u> 2</u>		Del Commercial SDU	<u> </u>	Deliver FFF	E				
						\dashv	_					Del Unit Tester			\mathbb{H}	OBC	ر د				
Ground Support Equipment deleted from HW Dev.	HW Dev.							Dage	-												

Page 1

A/O: 11/30/94

AR&C Ground Program Master Schedule

	CV 01		CO V.			60.00		-													
Activity Name	7	-	2 0	\vdash	+	<u>ا</u> ک	\perp	+	まし	ŀ	\dashv	5	CY 95		C	CY 96			CX 97		Г
	-	-	-4	5	1	7	3 4	4	2	3	4 1	7	8	4	7	3	4	-	2	3 4	
Simulation System Hardware			<u>-</u>					GP	GPS RF Simulator	rmulator	₹>		Procurement	-				╂	╂—		
SOFTWARE DEVELOPMENT														<u> </u>	S L		+	-	_	\perp	T
CDC SQUWATE											_SW	SW Test Plan	_ 	H	7		Deliver OBC Figt SW to FRL	Hgt SV	V to FR	+	
					Final _	Final SW MguDev Plan	Dev Pla	Plan O	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	<u>ት</u> ት		- " \	<u>دان</u> – – ه –	Celative F	Naviga	Lion SW		u	·		
			-						X		╬	<u> </u>				Figt SW	∇ Frelim OBC Figs SW to FRL				
Simulation System Software				-		-	1	Del GPS Digital Stat.	GPS Digital St	Stat.		VGS SW	MARCSIM	WIN T						_	
CVCTCM MEDIECATEON								WOW.	ici to rik					ig -	_8 -> - >-	cumenta 	Documentation Complete	omplete -			
TOTAL VEKIFICATION			+	_						-	_		-	-			\dagger	-	+	\downarrow	Т
lest Integration													-	-			+	+	+	+	
													₩	\mathbb{H}		Test —	Test Procedures	- E			
System Test			+			+	-	-		+	1		1	H							_
				 .													97	System Tests	Tests		
																	7	7	Test Reports		
Final Report			+				+			+			+	4			$\ \cdot\ $	\prod			
																<u> </u>		111.3	} }}		
			+	_		+	+							-				rina Kpt Complete			1
			-			+	+			+							+	+	_	_	
						-	-			+			-			-	+	+	\dashv	_	
		+	+			+	-						+			+		-	_		
			+				+										-	_	_		-
		$\frac{1}{1}$	+			+															
													_				-	-			_
																	-	-			-,-
							-											-	-		_
														<u> </u>			-	+-			-,-
														_			+		-	_	
								1	1				\dashv	╛		1	-	\dashv		_	

Ground Support Equipment deleted from HW Dev.

Nov 30, 1994

AR&C Systems Engineering Schedule - Baseline

	CY91 CY92 CY93	CY94	CVOS AVOR AVOR
Activity Name		┢	C130
	3 4 1 2 3 4 1 2 3 4	1 2 3 4	1 2 3 4 1 2 3 4 1 2 3 4
SYSTEMS ENGINEERING			
System Requirements			
AR&C			
Mission Analysis			Mission Analysis
Flight Design			Flight Design
Parametric Evaluation			Parametric Eval
Dispersion Analysis			Results Del
GN&C			Kesults Del
GN&C SW Equation Definition Document			D
Sensor Characterization Tests			
Simulation Runs			4
Open Loop Characterization			
Single Camera VGS			4
GPS			7
System Integration			
FRL Digital Open/Closed Loop Simulation Can			
VGS Breadboard Available			
Night Hawk Computer			
naloware distallation			

Nov 30, 1994

AR&C Systems Engineering Schedule - Baseline

A officier N.	CY91 CY92	CY93	CY94	CY95	96.K.D	CAA)
Activity Name	3 4 1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	_
Sim & DOTS S/W Porting	┩		,		<u>- ا</u>	1 2 3 4
OBC Commercial SDU Available			1			
Fortran GN&C S/W Installed						
Operational TPDM Available				7		
Statistical Model GPS Available			>			
Graphical User Interface Displays				>		
RF Simulator HW Delivered						
Initial AR&C System Development Cap.						
Preliminary Flight GN&C S/W						
Delivered to FRL		-				
Final GPS Nav Filter Delivered				<u> </u>		
FRL Ready for Flight GN&C S/W,						
Full FRI AR&C System Test Conshiller				>		
Preliminary Flight S/W Delivered						
Form, Fit & Function OBC Delivered				> 1		
Flight VGS Delivered					> [
Begin Statistical Evaluation of AR&C					> (
Systems					<u> </u>	
Project Level Documentation						
Level II Documentation						
Implementation Plan		Prelim		Final		
Level III Documentation						

Nov 30, 1994

AR&C Systems Engineering Schedule - Baseline

	76750	
Activity Name	C172 C173 C190	CY97
	3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1	2 3 4
System Requirements Document (SRD) (C. Cruzen)	Prelim T Final	
Verification Plan	Final	
Verification Requirements & Specification Document	Final	
Verification Requirements Compliance Document		Final Q
Interface Definition Document (IDD)	(1) Prelim Q Final	

Nov 30, 1994

AR&C Hardware Development Schedule - Baseline

A 54:::44:	CY91	CY92	22	_	CY93		ن	CY94		CY95	Z.		ر ح	¥		٤	2497
Activity Name	7 7	6	7	-	F	+	\vdash	ŀ	+		L	-	,	2	-	اد	/21
	_	7	7	T	6 7	4	7 7	5 4	-	2	3 4	_	7	ر س	4	7	3
HARDWARE DEVELOPMENT											┞		t	╂╴	┞	L	
Video Guidance Sensor (VGS)			-				-				-	1		+	\perp		
(K. Howard)															_		
Single Head Breadboard Model											-		1	-	+	_	
FFF Model VGS			-			•	-				-		\dagger	+	-		
Design/Packaging			-						1				+	+	+		
Procure/Build			_								-			-	+		
Cabling							_ 5		-				+	-	_ _	_	
FFF VGS Model Available			-				3							+	-		
VGS Sensor Specification & Drawings						+			> D		+			-	_		
Test			-						> '	D	Testing			-			
Flight Model VGS						-	-				+		1		_		
Design/Packaging			-			-					+			-	\downarrow		
Procure/Build			+			+					\mathbb{H}	Д		+			
Cabling			-			-			_ l				-		_		
Flight VGS Model Completed			-										-		_		
VGS Sensor Specification & Drawings			ļ								_	> D			-		
Test			-								-	>		ے ا		 onal omale	
Three Pt Docking Mechanism (TPDM)						-											<u> </u>
Electronics (B. Jacobs)					-	-					_		+	+	_		
Requirements													-				-
Specifications										1_	-		+	+	1	I	┪

AR&C Hardware Development Schedule - Baseline

***	CY91 CY92	CY93 CY94	20AJ 96AJ (AA)
Activity Name	3 4 1 2 3 4 1	1	112211
	C 7 1 4	?	4 1 2 3 4 1 2 3 4 1 2 3 4
Electrical Design			
Breadboards	Single C	Single Controller	Three Latch Controller
Parts Procurement			
PC Board Design			
Drawings			
Board Level Testing			Count Board
Validation of Design w/ Latch			Comm. Doard
Controller Available			
Validation of Design w/ TPDM			
Computer Interfacing			
Mechanism (J. Forbes)			
Proto-Flight TPDM			
Assembly			Latch 2 delayed due to mods
	-		Latch 3 delayed due to mods
		First Latch	TPDM Latches 4 delayed due to manpower
Integration of Breadboard Electronics			
Test Fixtures - Design			
Test Fixtures - Fab			
Testing Contact Dynamics			
Mechanism Available			TPDM Mechanism Ausilahla
TPDM Specificaton & Drawings			

Page 2

Nov 30, 1994

Nov 30, 1994

AR&C Hardware Development Schedule - Baseline

Cables (T. Deitrich) AR&C OBC (R. Humphries) Form Eit & Emotion Unit	7			
Cables (T. Deitrich) AR&C OBC (R. Humphries) Form Eit & Emotion Unit	4 1 2 2 4 1	3 4 1 2 3 4	1 2 3 4	1 2 3 4
AR&C OBC (R. Humphries)				
Form Lit & Emertion Ilait				
TOTAL TILOS L'UINCHOII CIIII				
Prototype Computer				
Design				
Procure Hardware & Software				
Breadboard Fab/Test		Test Complete		
Test Software	6			
Prototype Fab/Test				
Mechanical				
Design				
Procurement				
Boards				
Chassis				
Power Supply				
Design				
Procurement				
Breadboard Fab/Test				
Prototype Fab/Test				
Cabling				
Unit Assembly				

Nov 30, 1994

AR&C Hardware Development Schedule - Baseline

CY94 CY95 CY96 CY97	1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4		HHR IInit Delivered					Commercial SDU Available			Sin. Delivered to MSFC PROCUREMENT	S/W Upgrades Completed		DOTS Operational			
CY93	1 2 3 4																
CY92	1 2 3 4																
CY91	3 4									tone)							
Activity Name	Treating Maine	Unit Testing	Unit Delivery	Integration Support	Unit Tester	Procure Hardware	Test Software	Commercial SDU	Simulation System Hardware	GPS RF Simulator (MSFC) (T. Freestone)	Procure 20 Channel NTel Simulator (T. Freestone)	Computer & Software Upgrades (T. Bryan)	Overhead Crane Communication (T. Bryan)	Revalidate Crane Operation (T. Bryan)			

Nov 30, 1994

AR&C Software Development Schedule - Baseline

**************************************	CY91		CY92			CY93			CY94	4	CY95			CY9K	-	CAO.	5	Γ
ACTIVITY NAME	3 4	1	2 3	4	ī	2 3	4	-	2 3	4	1 2 3	4	,	\perp	-	5	\vdash	
SOFTWARE DEVELOPMENT			┟			-	-	1	-		-	╂	1		-	1	7	4
OBC Software (B. Thornhill)			-			+		+	-				-				-	\neg
Develop OBC Software Requirements						-			+				+		-		-	
Design & Code OBC Software	-				1	+			+				-		-			
MATRIXx	+					+		\parallel	-				1		_		\dashv	T
Delivery						-		+-	1				-		-			T
Training			-			+		-	┽▔				_				+	
Global Positioning System (GPS) (Lomas)					-	-		+	-				-				-	T
Develop S/W Reqts & Preliminary Algor.								<u> </u>	-						-			
S/W Put on Processor	-		<u> </u>		+			-	+				+				+-	
Software Devt & Testing at MSFC					1	-		-	-								-	T
Software Evaluation & Data Analysis	-				-			-	+-] [+						7
Deliver Relative Nav. S/W			-		+	_			+i		1	_ 						Т
Commercial SDU OBC Available					-	-		+		<u> </u>	>		-				-	
Flight OBC Available						-			+								+	
OBC Software Integration & Test					-	-		-	- Ger - Ein -		Prelim OBC S/W Del to FRL	P		Final Del to	Final OBC S/W Del to FRL	→ §§	_	
OBC Software Updates/Verifications					+	-		-	_				\mathbb{H}				+	
Documentation			-					-	+				\parallel		-	+	+	\neg
Software Management/Development Plan							Prelim	8		Final			<u> </u>					
Software Requirements Spec		-					Ľ.	Prelim				Final	-			+		
	1				\dashv	4		H	H					j			_	_

AR&C Software Development Schedule - Baseline

	CY9	91		CY92	Г		CY93			CY94		50AJ	CVOK	\ \	(CVO7	Γ
Activity Name		4	2	3	4	-	2 3	4		2 3	4	1 2 3 4	F	3 4	2 6	\vdash	
Software Design Spec		1	-	_		1	-		1	-	╨	, D			•	_	.]
Software Test Plan		 	-) • P					
Software Test Procedures		+	-			+			-	-							
Version Description Document		ļ	+							-							
Software Test Report		+							-	<u> </u>							
Software Audits	<u> </u>	ļ								_88 ▶	1,-	PDA CDA TRA	50	2 \$ [T -
GPS (J. Lomas)		+				+-						>	>	>			T
GPS Relative Nav. Filter S/W Test Plan							P _a	Prelim \	+	1		Final					1
GPS Relative Nav. S/W Design Spec.		 	ļ			<u> </u>		 				D					
GPS Relative Nav. S/W Mgmt Dev Plan	ļ		-			 			+								
GPS Relative Nav S/W Rqmts Spec	 	 	-				+		┦₽	<u> </u>							
GPS Relative Nav. Ground Test Report	-	-							-	+							
Simulation System Software (D. Allen)	+		-							+				-			T
Night Hawk Computer Available		ļ						•	+	+							
Simulation & DOTS Software Porting			-													+-	$\overline{}$
Graphic Users Interface			-														
Models		-	4							-							
Selection/Identification/Implementation														-			1
VGS Model Delivery		-	-		1			 	-	+-		D					
Vehicle Model Mods & Implementations	1			1		1	-			╬			Model Delivered	+ -		+	$\overline{}$
	$\frac{1}{2}$	\downarrow	\downarrow]	1	1	1	1	-	Н				- -	\exists	-	٦

AR&C Software Development Schedule - Baseline

CY91 CY92 CY93 CY94	3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1		lementations	tations	PS Receiver								
CY91	4 1 2 3	Environmental Model Mods & Implementations	Propulsion Model Mods & Implementations	IMU Model Mods & Implementations	GSP Statistical Model of a GPS Receiver								

A 24:-:\$4 MI	CY91	CY92	CY93	CY94	CY95	CY96	CV97
Activity Name	3 4 1	2 3 4	4 1 2 3	4 1 2 3	4 1 2 3	4 1 2 3 4	1 2 3 4
SYSTEM VERIFICATION							ì
Test Integration							
Installation & Prep of OBC Computer						1	
Installation & Prep of VGS							
Installation & Prep of TPDM							
FRL & Prep of Sim Sys Computer							
Test Procedures						7-7-	
System Test							
Design Verification							
Full System Demonstration							
OFF Nominal Conditions (Fault Tolerance)							
Installation & Prep Nav Filter						1	
Test Eval & Sim Lab Technical Support						>	
System Test Complete							
Test Reports Complete						-	4
Final Report						>	-
Data Evaluation							
Final Report							